2. (amended) A method of modeling a chamber of the heart in three-dimensions comprising:

collecting a set of points inside the heart, each point having coordinates in three-dimensional space;

computing the convex hull shape which estimates the boundary of the heart from the set of points:

resampling the computed hull shape on a regular grid to generate an enlarged set of points

smoothing said convex hull shape forming a mathematically differentiable shape approximating the physiologic shape of the heart chamber from said enlarged set of points.

## REMARKS

**Pending Claims:**

In this application, claims one through seven are currently pending. Independent claims one and two are amended by this Response. Entry of these amendments is respectfully requested.

**Rejection under 35 U.S.C. §102 and 103 (Geiser Patents)**

The Examiner has rejected the claims 1-6 under 35 USC 102(b) as being anticipated by Geiser, U.S. Patent 5,360,006 (the " '006 patent"). Claims 1-6 were also rejected under 35 USC 102(e) as anticipated by Geiser, U.S. Patent 5,797,396 (the " '396 patent"). Claim 7, which includes a limitation to the step of measuring cardiac wall acceleration, was rejected under 35 USC 103 as being obvious in light of either of the two cited Geiser patents.

The '396 patent has two of the same three inventors as the '006 patent, and includes much of the same disclosure as the older '006 patent. Both patents disclose a method of automatically determining the heart wall boundaries that are shown in an echocardiographic image obtained through ultrasound. Once the heart wall boundaries are found in the image, the two-dimensional area of the heart chamber and the movement of the heart walls can be analyzed.

Both the '006 patent and the '396 patent start with a digitized, gray scale, two-dimensional image of the heart produced by ultrasound equipment. The method of the '006 patent then locates the approximate center point of the left ventricle in the image using circular arc filters. (Col. 5, line 45 through Col. 6, line 51). The circular arc filters function by selecting various pixels in the image as possible center points, and then calculating pixel intensities at various radii from the selected center point. By comparing the total pixel intensities at numerous possible center points and radii, the system can approximate the center point of the left ventricle. (Col. 6, lines 23-51). Circular arc filters are then used to determine the anterior endocardial and epicardial border. (Co. 7, line 67 through Col. 8, line 49). The approximation of the left ventricle center point is then improved using the results from the anterior border calculations. (Col. 8, lines 50-68). Circular arc filters are then used to determine the lateral epicardial and endocardial borders. (Col. 10, lines 11-34). The final epicardial and endocardial borders of the left ventricle are then represented by curves formed as the union of six elliptical arcs (each representing a quadrant of the ellipse) spliced together. (Col 10, line 35 though Col. 12, line 42).

The method of the '396 patent adds the use of elliptical arc filters to find wall boundaries in addition to circular arc filters (Col. 8, lines 7-33; Col 15, line 56 though Col. 18, line 24; and Col. 20, line 51 through Col. 24, line 47). Like circular arc filters, these elliptical arc filters use pixel intensities to help find the epicardial and endocardial boundaries. The '396 patent also disclosed alternate ways to use circular arc filters to find wall boundaries. (Col. 11, line 1 through Col. 13, line 16).

Thus, both of the Geiser patents disclose a method of taking a visual, two-dimensional ultrasound image of the heart and mathematically determining the location of endocardial and epicardial borders on that image by examining pixel intensities. Both Geiser patents deal exclusively with a two-dimensional echocardiographic image, and do not create a three-dimensional model of a heart. In contrast, amended independent claims 1 and 2 both recite a method of "collecting a set of points inside the heart, each point having coordinates in three-dimensional space" for the purpose of "computing the convex hull shape which estimates the boundary of the heart from the set of points." The Geiser patents do not teach or suggest a method of collecting points in three-dimensional space, nor do the Geiser patents teach or suggest a process for computing a convex hull shape based on the collected three-dimensional

points. Since all of the dependent claims depend upon amended independent claim 2, none of the claims should be considered anticipated by or rendered obvious by the Geiser patents.

**Rejection under 35 U.S.C. §102 (Ben-Haim Patents)**

The Office Action further rejected claim 1 under 35 USC 102(e) as anticipated by Ben-Haim. The Office Action did not specify which Ben-Haim patent was the basis for this rejection. The Applicant believes the Examiner is referring to U.S. Patent No. 5,738,096 issued to Shlomo Ben-Haim on April 14, 1998. The Applicant will respond to this rejection with the assumption that this is the patent referred to in the Office Action.

While Ben-Haim discusses the desirability of constructing a three-dimensional map using positions obtained from the tip of a located catheter, Ben-Haim does not present any method for creating such a map. Claim one requires a calculation of a convex hull algorithm for modeling a chamber of a heart. Ben-Haim includes no teaching of using a convex hull calculation. Since there is no such teaching, or even a suggestion of using a convex hull calculation, this independent claim is not anticipated or rendered obvious by Ben-Haim.

**CONCLUSION**

All of the claims in this application should now be seen to be in condition for allowance. The prompt issuance of a notice to that effect is solicited.



Respectfully Submitted,
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